M E M O R A N D U M

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SUBJECT: **Estimation of Brighton Seminole Indian Reservation Demands for use with South Florida Water Management Model V5.0**

Introduction:

Demand estimates for the Seminole Brighton Reservation (located in the Lower Istokpoga Basin northwest of Lake Okeechobee) are a required input to V5.0 of the South Florida Water Management Model (SFWMM). In order to be consistent with the modeling approach to estimate demands and runoff in other non-gridded portions of the SFMWW, Version 3.0 of the AFSIRS/WATBAL model (Wilcox 2003) is an appropriate tool for this task. This memo will review the following topics: 1) AFSIRS/WATBAL model calibration results for the Brighton / Istokpoga area and 2) model application including entitlement check.

AFSIRS/WATBAL Model Calibration Results[1]:

The Brighton / Istokpoga implementation of the AFSIRS/WATBAL model is conceptualized as a single basin model covering the lands between S-70/S-75 and S-71/S72 that influence the regional system. This area includes the Seminole Brighton Reservation as well as additional irrigated and non-irrigated lands. In general, reliable flow and land use data in the defined basin is limited. While flow data exists for the last several decades, it contains large periods of missing data and a water budget analysis created by utilizing these flows shows several months of unrealistically high or low demand conditions. Land use data for the basin is also in short supply, especially before the 1995 flux land use coverage. Due to these data limitations, a calibration period of 1995-2000 was selected. While this is a relatively short period of simulation, it should prove sufficient for parameter estimation, especially since the model will be applied with land use assumptions consistent with circa-2000 conditions. Once the calibration period was selected, historical flow data for boundary structures (S-70, S-71, S-72, S-75, G207 and G208) was obtained from the SFWMD's DBHYDRO database. Additionally, a historic land use table was developed based on a combination of District land use coverage for 1995, 2000 permitted agricultural land use as used in Supply Side Management implementation (SFWMD 2002) and

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[1] *Results of the Brighton Reservation / Istokpoga calibration of the AFSISRS/WATBAL model as well as supplemental support information and input data have been archived in the SFWMM compact disk repository on "CD-SFWMM-091003-1".*

land use as defined in the Work Plan authorization as per the 9/13/02 letter from Lewis, Longman & Walker to Jayantha Obeysekera, SFWMD (Attachment 1).

Once data had been collected, an iterative calibration process was attempted in a manner similar to that undertaken for the C43 AFSIRS/WATBAL model (Wilcox 2003). The goal of the Brighton / Istokpoga calibration was to be able to match a measured demand condition as closely as possible. Due to this consideration and also taking into account the uncertainty in measured data for the Brighton / Istokpoga model, many of the C43 calibrated model parameters were incorporated without modification. In fact, only two of the AFSIRS/WATBAL model parameters were modified during calibration. These demand related calibration terms were the irrigation efficiency [EFF1] and the Local Storage Depth [STOR1]. The final results of the iterative process yielded calibrated parameters as shown in Tables 2.1 and 2.2 (with rangeland Kc factors from C43 being applied to pasture/sod in Brighton / Istokpoga). Calibration summaries and Goodness Of Fit (GOF) analysis of agricultural demands are presented in Table 2.3 and Figures 2.1 to 2.3.

In general, results of this calibration exercise are acceptable, although not as good as those observed in the C43 for AFSIRS/WATBAL V3.0. The main strength of the calibrated model is its ability to predict the timing of when periods of demand occur. Calibration of the Brighton / Istokpoga basin to both timing and magnitude of demand was significantly harder than for the C43 due to the previously outlined data issues in conjunction with the relatively small magnitude of demand in the basin. Additional, more specific, comments related to the calibration results are presented in bullet form below.

- The calibrated EFF1 term was lowered to 60% (from 87% in the C43) indicating an increase in un-captured loss terms. Having said this, this term still falls well within the range of reasonability and is on the same order as previous modeling exercises for the C43 with AFSIRS/WATBAL V2.0 for the LEC plan (58%).
- The change in STOR1 from 0.1 inches to 0.2 inches represents increased uncertainty in water table fluctuation.
- The correlation of measured to modeled demand is good overall, with the exception of a few outlier points - May 2000 in particular. In this month, the modeled demand is over double the magnitude of the measured basin demand. This inconsistency is clearly evident in both the scatter plot (Figure 3.1) and the seasonal variability (Figure 3.2), which shows a marked bias in "overestimation" of May demand. It is strange that measured demand is not higher given that May 2000 was one of the driest months in history and this observation may point to problems with the measured data.
- The model tends to slightly under-predict demand in earlier years and then over-predict in later years - this is most likely due to inaccurate estimate in the land use data which was assumed to be constant during the calibration period due to the lack of reliable data related to land use growth.

Based on the results of the Brighton / Istokpoga calibration exercise, it seems appropriate to apply the AFSIRS/WATBAL V3.0 model in regional modeling efforts associated with demand estimation for the Brighton Reservation.

Table 2.1 - Calibrated Values for AFSIRS Water Budget Model Parameters

Irrigation efficiency1 (consumptive use by plant / amount lost to air) [EFF1]	60%
Local Storage Depth (inches) [STOR1]	0.20
Drainage capacity (inches/day) [CAP1]	7.00
Storage coefficient (day) [COEF1]	7

Table 2.2 - Values for Monthly PET Correction Factors (Kc) as Calibrated in C43 Basin

month	citrus	cane	pasture/sod
1	0.71	0.61	0.54
2	0.66	0.57	0.55
3	0.61	0.51	0.55
4	0.64	0.59	0.75
5	0.87	0.88	0.89
6	0.98	0.98	0.99
7	1.02	1.07	1.03
8	0.83	0.90	0.88
9	0.93	1.00	0.91
10	0.99	1.00	0.83
11	0.84	0.80	0.60
12	0.82	0.72	0.53

Table 2.3 - Measures of Goodness of Fit for Calibration of AFSIRS Water Budget Model

| *Average Annual Demand*	
Demand – Modeled	49,723 ac-ft/yr
Demand – Measured	49,514 ac-ft/yr
Goodness of Fit	
Model-Measured Error	209 ac-ft/yr
Demand (Model)- Demand (Measured) / Demand (Model)	2.36%
Slope of Modeled - Measured Demand	0.933
Regression Coefficient of Modeled - Measured Demand	0.507
Pearson Correlation Coefficient	0.712
Modeled Bias	-17 ac-ft
Root Mean Squared Error	3032 ac-ft

Calibration of Brighton Reservation / Istokpoga Demand (1995-2000)
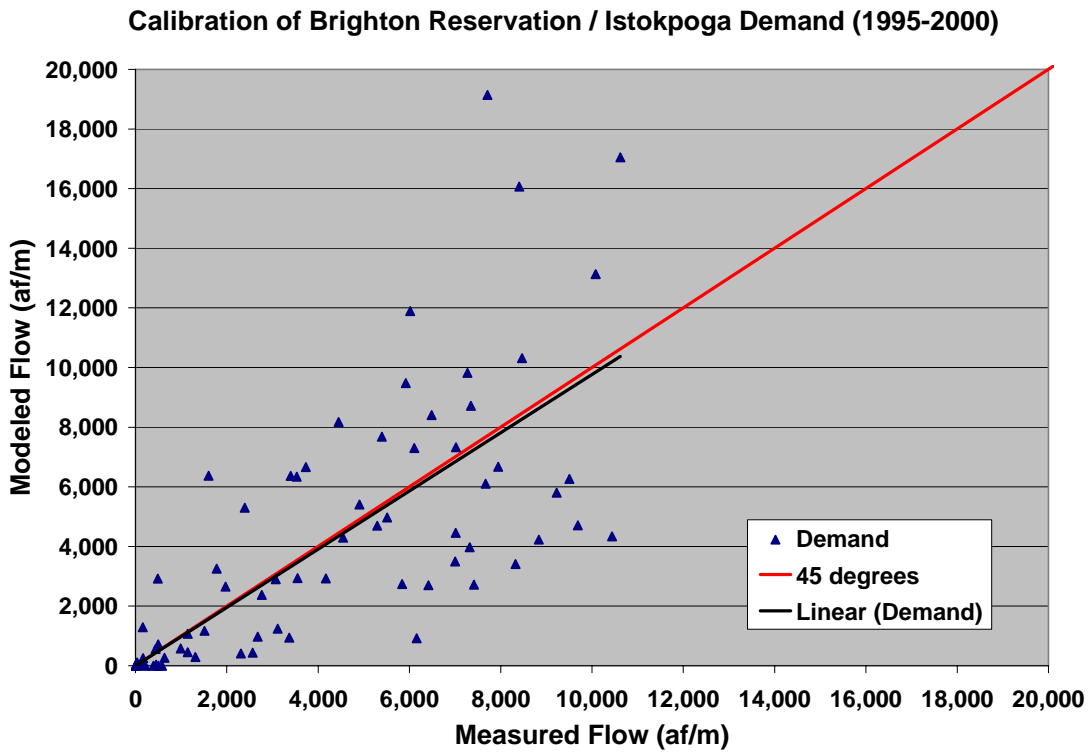
Figure 2.1 –Measured vs. Modeled Brighton/Istokpoga Demand

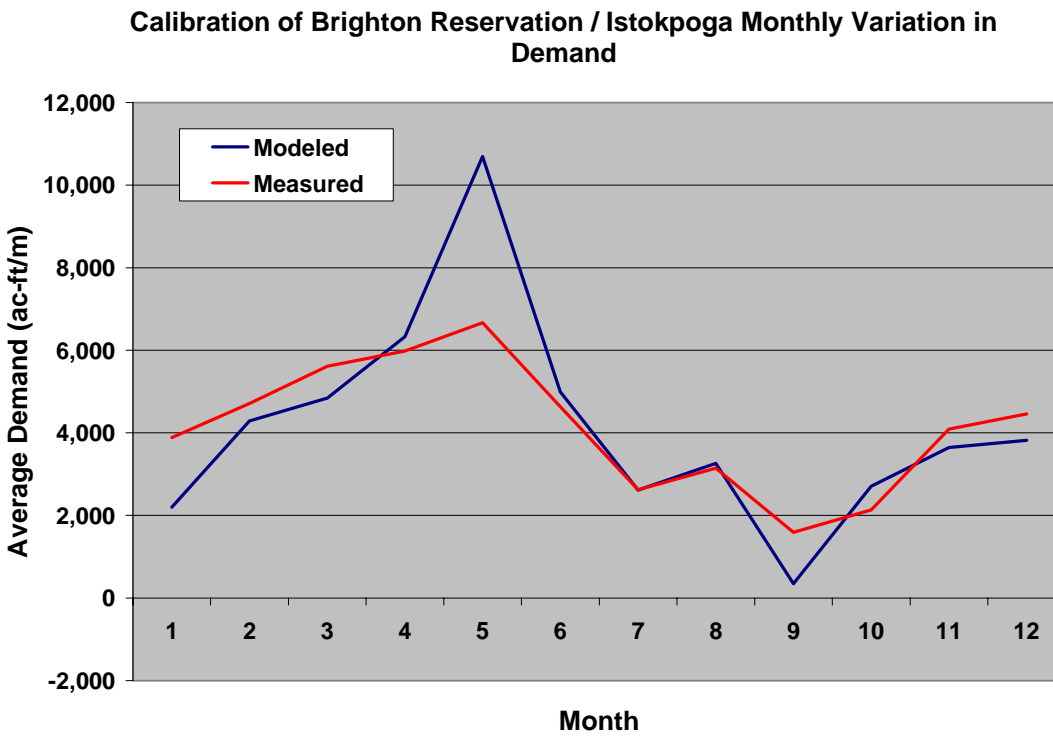**Calibration of Brighton Reservation / Istokpoga Monthly Variation in Demand**

Figure 2.2 –Seasonal Variability in Brighton/Istokpoga Demand

Calibration of Brighton Reservation / Istokpoga
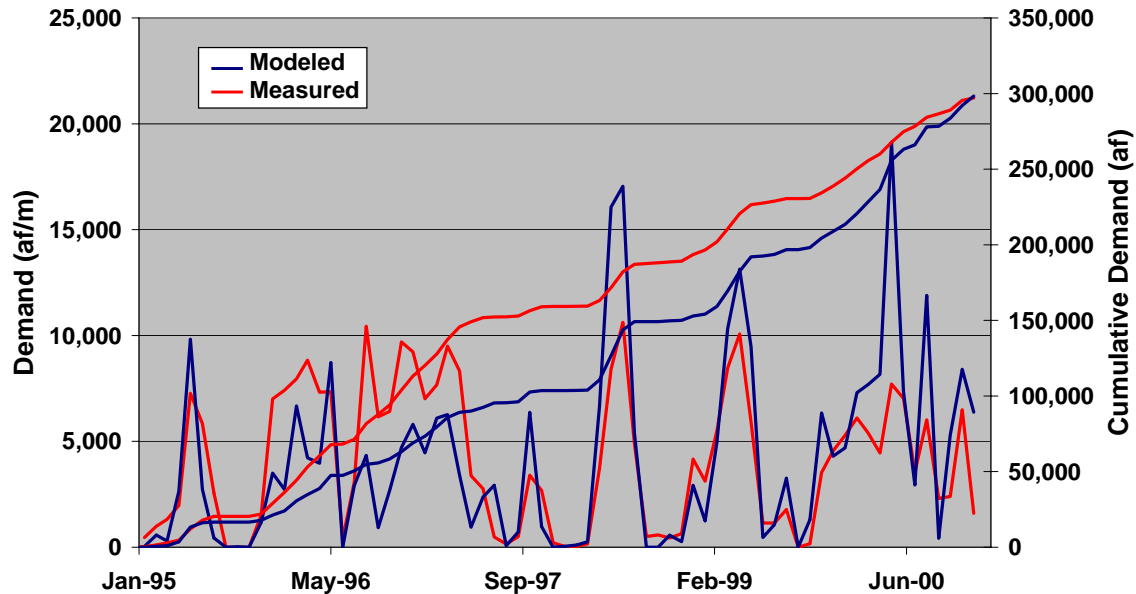**Demands on Regional System: 1995 - 2000**

Figure 2.3 –Time Series of Monthly Brighton/Istokpoga Demand and Accumulation

AFSIRS/WATBAL Model Application:

Following the Brighton / Istokpoga calibration exercise, V3.0 of the AFSIRS/WATBAL model was run using calibrated parameters and land use as defined in the Work Plan authorization outlined in the letter from Lewis, Longman & Walker. A daily time series of Brighton Reservation demand was calculated for the period 1965-2000. This time series was then modified by a rescaling program (Cadavid) which imposes a daily maximum of 530 ac-ft (the combined conveyance of the g207 and G208 pump stations) and attempts to obtain an annual average of 28,500 ac-ft over the period of simulation (consistent with release volumes over the last several years). While the impact of this rescaling was large in previous modeling efforts, the calibration exercise for the Brighton/Istokpoga area reduced the impact of rescaling, effectively making the program only a check on conveyance limitations. Results of the rescaled time series are presented in Table 3.1. As can be seen the 2/10 monthly demand in the time series is in agreement with (and actually exceeds) the entitlement delivery requirement for the Brighton Reservation.

Table 3.1 – Comparison of Modeled Demands to Work Plan Entitlement for
Seminole Brighton Reservation

As modeled with AFSRIS/WATBAL and rescaling for 1965-2000 period.	Average Annual Demand (ac-ft)	28500
	Max Monthly Demand (ac-ft)	10348
	Max Monthly Demand (mgm)	3374
	Monthly 2/10 Demand (mgm)	**2383**
From Work Plan 2/10 Demand (mgm)		**2262**

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